Technology Opportunity

CARES (Ceramics Analysis and Reliability Evaluation of Structures) Integrated Design Software

The National Aeronautics and Space Administration (NASA) seeks to transfer design methodologies and attending software that enable significant improvements in assessing the integrity and reliability of advanced structural ceramic and brittle material components.

Potential Commercial Uses

- Aerospace applications
- Automotive applications
- Propulsion and power applications
- Bioengineering applications
- Glass and other applications

Benefits

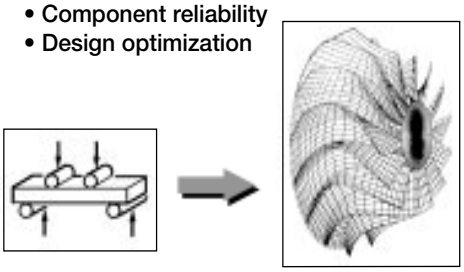
- Accelerates commercial application of high-value added materials
- Enables accurate life prediction of brittle material components by heretofore unavailable computer simulation and design

The Technology

Researchers in the Structural Integrity Branch at the NASA Lewis Research Center have conceived and developed the CARES (Ceramics Analysis and Reliability Evaluation of Structures) integrated design software series, a general-purpose design tool that provides an innovative, cost-effective approach to systematically optimize the design of brittle material components using probabilistic reliability analysis techniques. Utilization of this software optimizes component design and manufacture on the basis of reliability and, consequently, achieves the best use of high-value-added ceramic and other brittle material systems in critical structural components subjected to tensile thermomechanical stresses. This software combines multidisciplinary research—in fracture analysis, probabilistic modeling, model validation, and brittle structure design—with extensive computational capabilities into one comprehensive package to perform accurate computer simulation prior to costly component fabrication. Input for this software includes material data from simple experiments and stress and temperature distributions obtained from finite element analysis (FEA) of complex components. The CARES software is coupled to several commercially available FEA programs, to yield an integrated design tool that government, industry, and academia can adapt to their local computing environment.

CARES Probabilistic Component Design Procedure

- Ceramics are brittle and have many flaws
- Random flaw size & orientation require probabilistic design methods
- Approach
  - Material failure characterization
  - Fractographic examination of ruptured specimens
  - Component finite element analysis
  - Component reliability
  - Design optimization



Simple Test Specimens

Complex Component Predictions

National Aeronautics and Space Administration
Lewis Research Center

Options for Commercialization

The NASA Lewis Research Center continually seeks cooperative partnerships with industry, government, and academia to develop new brittle-material life-prediction capabilities, further enhance existing technology, and provide valuable exchange of information on current structural ceramics research activities. The CARES series of software and the expertise of the developers are available to all interested organizations. This includes maintaining a CARES "hot line" consultation service, visiting customer sites, training, and upgrading the CARES software.

Contact

Lesley A. Janosik
Structural Integrity Branch
NASA Lewis Research Center
Mail Stop 6-1
21000 Brookpark Road
Cleveland, OH 44135
Phone: (216) 433-5160
Fax: (216) 433-8300
E-mail: lesley.a.janosik@ lerc.nasa.gov

Key Words

Ceramic
Reliability
Life prediction
Design
Finite element analysis
CARES

M-0239-14

National Aeronautics and
Space Administration
Lewis Research Center